OPERATING INSTRUCTIONS

TYPE 1116-B

EMERGENCY POWER SUPPLY

GENERAL RADIO COMPANY

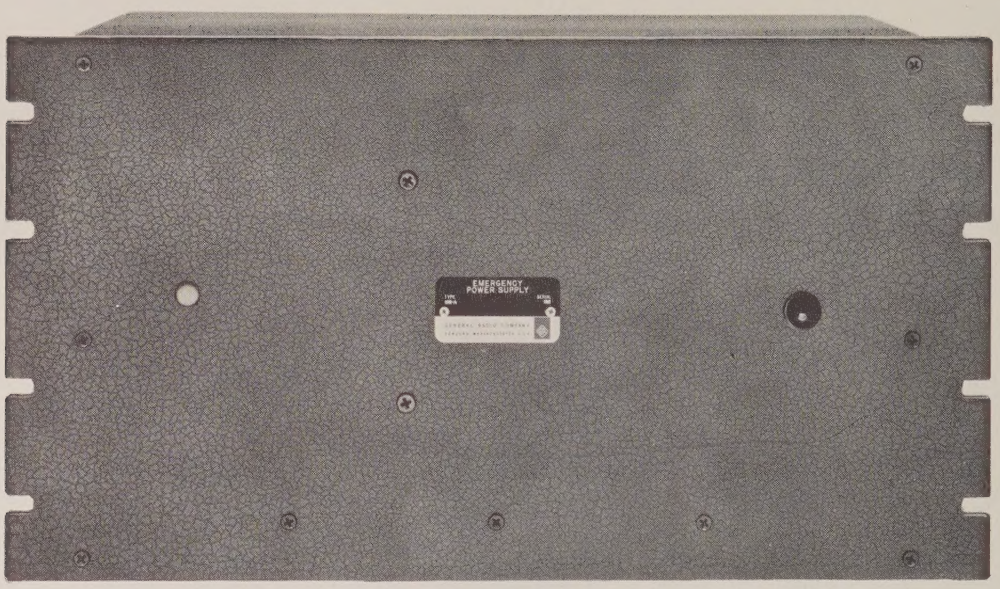


Figure 1. Type 1116-B Emergency Power Supply.

SPECIFICATIONS

Input: 115/230 v, 50-60 cps from power line (refer to Section 2)
28-32 v, 7-5 amp from battery (when operating Type 1120-A Frequency Standard)
28-32 v, 10-7.5 amp from battery (when operating Type 1100-A Frequency Standard).

Output: 115 v, nominal, 60 cps, 180 watts continuous maximum rating.

Operational Range: Battery cuts in when line voltage falls below 105 v and cuts out when restored line voltage reaches a preset value between 108 and 113 v ac.

Accessories Supplied: Type CAP-22, 3-wire power cord (2); spare power line fuses (2).
Power-Supply modification kit included used only with Type 1100-AP.
Type CAP-15-4 power cord and rack-support set added when part of Type 1120-A.

Accessories Required: 28-, 30-, or 32-v battery and cables.

Accessory Available: Type 1268-A Automatic Battery Charger.

Dimensions: Width 19 in., height 10½ in. (485 by 270 mm), depth behind panel 13 in. (330 mm).

Net Weight: 58½ pounds (26.6 kg).

SECTION **1**

INTRODUCTION

1.1 PURPOSE. The Type 1116-B Emergency Power Supply (Figure 1) is a combination inverter and switching device, which, when used with a 28 - 32-volt storage battery, provides continuity of 115-volt ac supply despite interruption of normal power service. Although primarily designed as an emergency supply for the Type 1120-A Frequency Standard, the Type 1116-B can operate any 115-volt, 60-cps equipment within its continuous power rating of 180 watts. When used with the Type 1120-A (or its predecessor, Type 1100-A)*, the unit powers the three major components in the system for which continuous operation is important. They are:

(1) Type 1113-A Standard Frequency Oscillator
(2) Type 1114-A Frequency Divider
(3) Type 1103-B Syncronometer

All three must be connected to the 115 V AC OUTLET of the Type 1116-B and <u>never</u> directly to the primary power source.

1.2 DESCRIPTION. The Type 1116-B Emergency Power Supply is housed in a 16 1/2 by 10 1/2 by 12-inch cabinet, with a 19 - inch, gray-crackle-finished panel for relay-rack mounting. On the rear apron of the instrument are three toggle switches (Figure 2), which make or break the battery input (S1), line-voltage input (S3), and 115-volt output (S2) connections. Also at the rear are fuse holders that contain the line-input fuses, and connectors for normal line-voltage supply, battery, and devices being operated.

*Type 1101-A or -B Standard Frequency Oscillator, Type 1102-A Multivibrator and Power Supply, and Type 1103-A (or -B) Syncronometer. The power input connection for these three units is on the Type 1102-A.

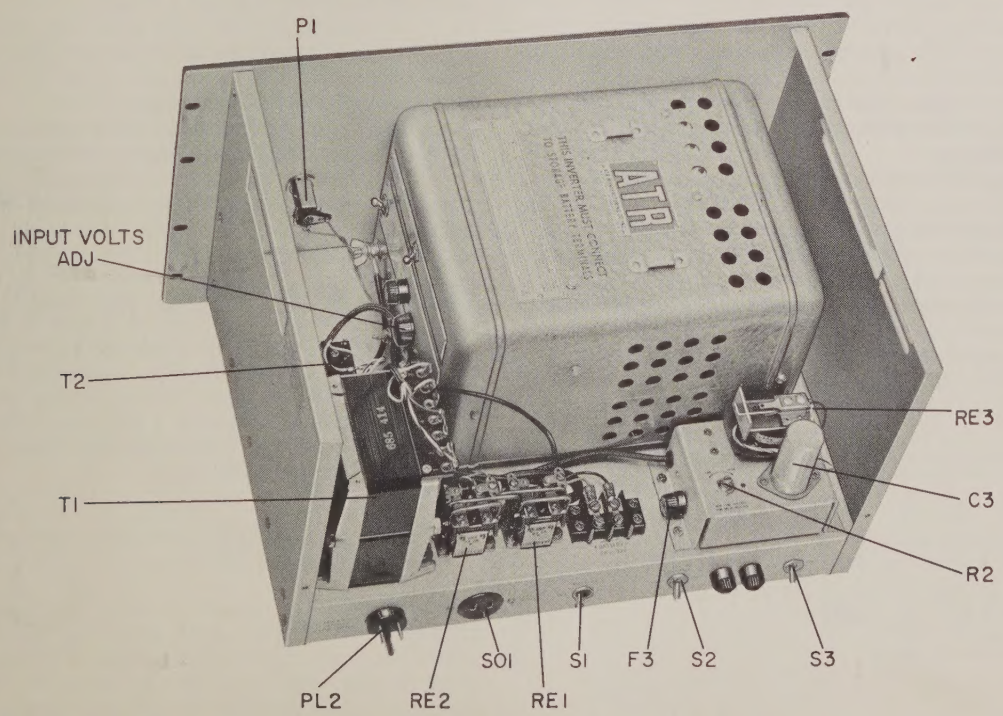


Figure 2. Type 1116-B Emergency Power Supply, Rear Interior View.

1.3 ACCESSORIES SUPPLIED. Two 7-foot, 3-wire power cords, Type CAP-22 are supplied with every instrument as are two spare fuses (2 amp rating for units wired for 115 v or 1 amp for units wired for 230 v). Also supplied, but needed only when the Type 1116-B is to be used with a Type 1100-AP Frequency Standard, is a modification kit to provide additional storage for the Type 1103-A Syncronometer. The kit consists of three 5-μf filter capacitors (Part No. 4510-1400), one 750-ohm, 1-watt resistor (Part No. 6760-1755) and mounting hardware. When supplied as part of the Type 1120-A Frequency Standard, a Rack Support Set (Part No. 7860-9806) and a Type CAP-15-4 power cord are provided.

1.4 ACCESSORIES REQUIRED. Nickel-cadmium type batteries provide a relatively constant output voltage during discharge and are generally quite satisfactory for this application. Other battery types, such as lead-acid cells, may be used but generally do not supply as constant a source voltage.

1.5 ACCESSORY AVAILABLE. To ensure that the battery is maintained at an optimum charge at all times, use of the General Radio Type 1268-A Automatic Battery Charger is recommended. For details on installation and operation of the Charger with the Type 1116-B, refer to separate operating instruction for the Type 1268-A.

SECTION **2**

PRINCIPLES OF OPERATION

2.1 GENERAL. (See Figure 3.) Upon failure of the 115/230-volt ac line voltage, the relays in the Emergency Power Supply:

(1) connect the vibrator-type inverter to the battery;

(2) transfer the power-input terminals of the frequency standard (or other device) to the inverter output;

(3) determine the transfer voltage, and;

(4) turn on emergency operation indicator.

This change-over is accomplished so rapidly that, with a normally operating frequency standard, no interruption in operation occurs. A front-panel lamp glows when battery power is in use.

On resumption of regular line service, the relays:

(1) disconnect the inverter from the battery, and;

(2) connect the power-input terminals of the frequency standard (or other device) to the normal power supply.

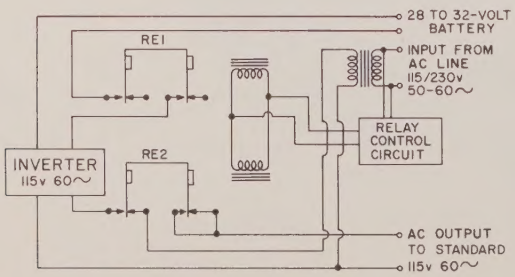


Figure 3. Elementary Schematic Diagram for Type 1116-B.

2.2 OPERATIONAL RANGE. (See Figure 7.)

A tapped transformer in the ac line input to the Emergency Power Supply (T2), operated in conjunction with the relay control circuit, maintains uniform pick-up and dropout voltages for operation of the relays. The power transformer (T1) permits 115-volt operation of the frequency standard (or other device) with either 115- or 230-volt input.

NOTE

The output of the Emergency Power Supply is always 115 volts.

If the normal power system is at 60 cps, the frequency of the Type 1116-B output is the same during normal and emergency operation. If the power system is at 50 cps, the output of the Type 1116-B is 50 cps during normal service and 60 cps during emergency service. This change in supply frequency output will not affect operation of a frequency standard.

The inverter output voltage will vary a few volts as the heater of the frequency standard (around 12 watts) cycles on and off. This variation is perfectly normal, caused by the appreciable internal resistance of the inverter. The inverter output waveform occurring under normal operating conditions appears in Figure 4. Note the absence of severe voltage transients.

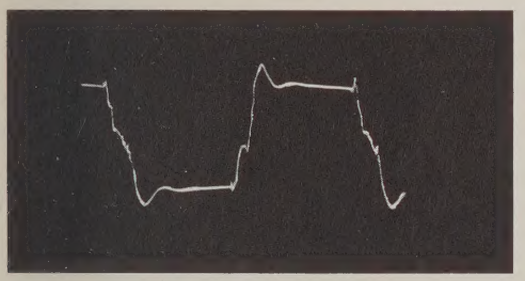


Figure 4. Output Waveform of Type 1116-B on Battery Power.

There are three relays used. Two, RE1 and RE2, are 115-v ac relays which perform the power-switching operation. The third relay, RE3, a nominal 12-v dc unit of the snap-action type, is the principal element in the control circuit which determines the exact ac-voltage levels at which the system switches between line and battery sources.

2.3 RELAY CONTROL CIRCUIT. The relay control circuit subassembly is a small chassis that is mounted on top of the main chassis, behind the inverter unit. The functions of the relay control circuit are:

(1) to initiate immediate, uninterrupted operation of the Emergency Power Supply on battery-input power whenever the ac line voltage falls below 105 v, and;

(2) to provide positive switching from battery to ac line power when the ac line is above the turn-on voltage of the relay circuit.

A small hysteresis, see Figure 5, is designed into the switching sequence. When the ac line voltage is increasing, the control relay will switch to ac line power as the line voltage reaches a value between 108 and 113 volts. If the line voltage has been above this value and

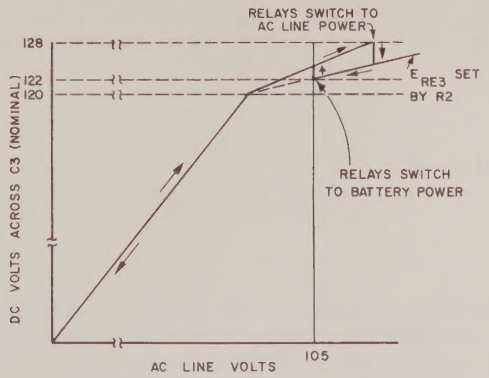


Figure 5. Control-Circuit Operation Path.

is decreasing, the relay switches to battery power at 105 volts.

The ac line voltage is supplied to the autotransformer, T2, and transformed to the proper voltage to operate both the power- and the control-relay circuits. This voltage is then applied to the arm contact of RE3 through fuse F3. The lower contact of this relay, which is closed when the relay is not energized, shunts R2, supplying full voltage to surge-limiting resistor R3 and diode CR1. This diode rectifies the ac voltage and charges capacitor C3.

When the voltage across C3 exceeds the breakdown voltage of the Zener reference diode, CR2, current flows through this diode and through the coil of RE3. When the developed dc voltage is more than 8 volts in excess of the Zener reference voltage (120 v dc ±5%), the relay operates, closing the circuit to energize the coils of RE1 and RE2 and opening the lower contact. The opening of this contact removes the short across resistor R2 and lowers the voltage applied to the rectifier diode circuit.

If the line voltage drops, the voltage across the coil of RE3 also drops, causing this relay to open when the voltage becomes less than approximately 2 volts. By setting resistor R2, it is possible to adjust this release point to occur at precisely 105 volts, ac. (This adjustment is made at the factory initially.)

SECTION **3**

INSTALLATION

3.1 GENERAL. Connect a 28- to 32-volt storage battery of suitable capacity (the Type 1116-B draws about 10 amp max) to the BATTERY connector on the Type 1116-B, observing polarities indicated on the terminals. Connect the normal 115/230-volt supply line to the 115/230 V LINE INPUT connector, and connect the frequency standard (or other device) to the 115 V AC OUTPUT connector. Turn inverter switch to proper position as given in the following table.

INVERTER SWITCH POSITIONS FOR TYPE 1120-A OPERATION
(See Figure 2)

DC INPUT		AC OUTPUT		INPUT VOLTAGE ADJUST.
VOLTS	AMPS	VOLTS	WATTS	
24*	7.0	117	121	MAX
26*	6.3	116	119	HIGH
28	5.0	108	106	MED
30	5.0	112	116	MED
32	4.4	105	105	LOW

* Not recommended.

NOTES:

(1) Above data taken using ATR Type 28U model RHG with Type 1120-A for load and with both Type 1113-A ovens on.

(2) Type 1103-B starting motor not used for load.

(3) Type 1114-A P1 through P7 plug-ins in use.

(4) Thus, for a 25-cell, nickel-cadmium battery (normal voltage 32.5 to 28.8 volts), use MED; for a 22-cell unit (28.6 to 25.3 volts), use HIGH. If the battery voltages differ materially from the above, adjust accordingly.

3.2 TRANSFORMER T1. Make sure that transformer T1 is properly connected for the normal supply voltage. For 105-125 volt input, terminal 1 should be connected to terminal 3, and terminal 2 to terminal 4. For 210-250-volt input, connect terminal 2 to terminal 3 (see Figure 7).

3.3 TRANSFORMER T2. The line-voltage input connects to terminal 1 of transformer T2 through a common connection which is made at the factory. For 115-v operation, connect the other side of the line to terminal 3 of transformer T2; for 230-v operation, connect the line to terminal 6. The relay-control-circuit tap on T2 must be selected to provide the dc turn-on voltage for the control relay, RE3. The selection of this tap can be approximated by reference to the chart included on the circuit diagram given in Figure 7. Since the operating current of RE3 may vary slightly with different units, the choice of tap may be determined as follows:

a. Using a Variac® autotransformer, adjust the input line voltage, as indicated by an accurate ac voltmeter, to a value slightly below 105 v. RE3 should not operate at this voltage.

b. Slowly increase the input until the relay operates and note this voltage. If it is between 108 and 113 (or 216 and 226), the proper tap has been selected.

c. If the voltage is not within these limits, tap 2, 3, or 4 can be used for 115-v input and tap 5, 6, or 7 for 230-v input to obtain turn-on at the desired input line voltage.

d. To check the point of change-over to battery power, increase the input voltage above the relay-closing point; then slowly reduce the voltage. If the relay releases at 105 (or 210) v, the setting of R2 is correct. If not, R2 can be readjusted to obtain switching at 105 (or 210) v.

R2 is a screw driver-adjustable potentiometer control at the rear of the chassis (see Figure 2).

3.4 SYSTEM VARIATIONS. The Type 1120-A Frequency Standard includes the Type 1103-B Syncronometer, which incorporates its own ac line-operated power supply with adequate storage capacitance in its filter to keep the Syncronometer in operation during change-over to a battery supply. No additional capacitors are required for the Type 1103-B Syncronometer. For use with the older Type 1103-A Syncronometer, refer to Section 4.

3.5 TURN-ON. Before turning on the switches on the rear apron of the unit, make sure that the ON/OFF switch on the inverter is in the ON position, and the TAPE-RECORDER/TELEVISION SET switch is in the TELEVISION SET position. When all necessary connections have been made, snap all three toggle switches ON to place the unit in operation.

3.6 OPERATION CHECK. To check the operation of the Type 1116-B Emergency Power Supply, throw the 115-230-volt LINE INPUT switch to OFF. The frequency standard (or other device) should continue to operate and the front-panel lamp on the Type 1116-B should glow. Return the LINE INPUT switch to ON. Again operation should be continuous.

SECTION 4

USE WITH TYPE 1103-A SYNCRONOMETER

4.1 GENERAL. If the synchronous motor of the Type 1103-A Syncronometer is not in good mechanical condition, interruption of service may occur upon change-over from regular to emergency service. Additional filter capacitors for the Syncronometer are supplied with the Type 1116-B Emergency Power Supply to provide an additional safety factor. However, if the 1-kc synchronous motor is in poor condition, even this modification may not be enough to prevent interruption of service. After installation of the additional capacitors as described in paragraph 4.2, check the performance of the motor as described in paragraph 4.3.

A schematic diagram of a Syncronometer modified for use with the Type 1116-B is given in Figure 8.

4.2 INSTALLATION OF FILTER CAPACITORS IN SYNCRONOMETER. (See Figure 6.)

a. Disconnect slate (green tracer) wire from rear of plate fuse holder, and tape end of wire (or cut off at braid).

b. Disconnect slate (green tracer) from terminal 3 of connector PL1, and tape end of wire.

c. Connect 750-ohm, 1-watt resistor supplied (R6) between terminal 3 of PL1 and rear terminal of fuse holder

d. Mount three filter capacitors supplied (C5A, C5B, C5C) on rear of chassis base (note drilling layout), moving cable to make room, as shown.

e. Connect three capacitors in parallel.

f. Connect one set of terminals to terminal 4 of PL1.

g. Connect other set of terminals to rear terminal of the fuse holder.

4.3 SYNCRONOMETER TEST. To check the operation of the 1-kc synchronous motor, place the frequency standard in normal operation, and, when the second hand of the Syncronometer reaches a cardinal point, quickly snap the PLATE switch OFF. The motor should coast for at least eight seconds (on the clock face; longer in actual time). If the motor coasts less than eight seconds it may stop during change-over to emergency service. In such instances, the cause of the abnormally high friction should be determined and the condition corrected.

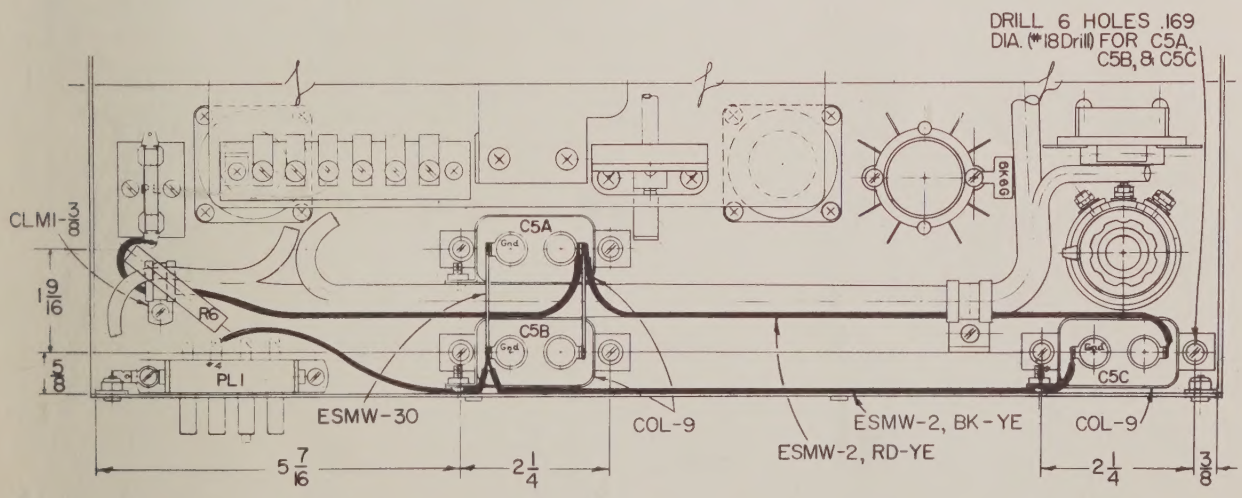


Figure 6. Type 1103-A Modification Kit Installation, Top Rear View.

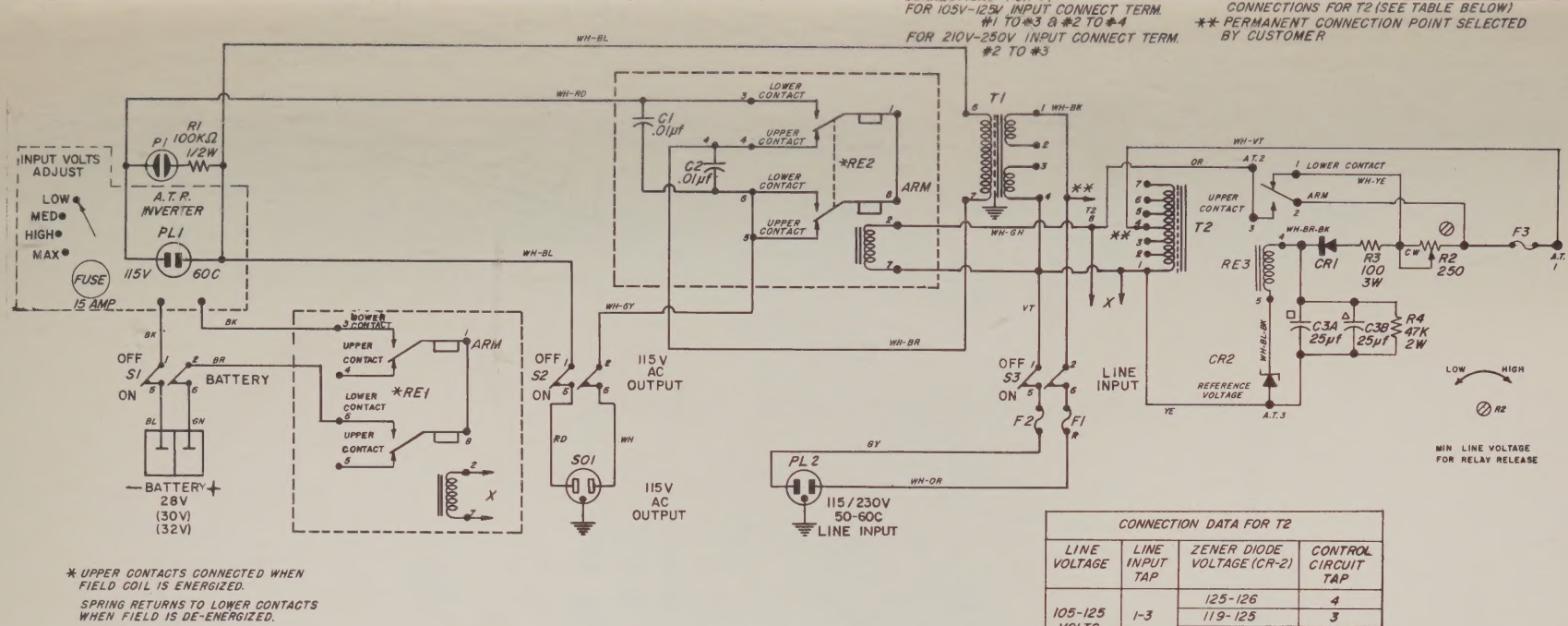
SECTION 5

SERVICE AND MAINTENANCE

5.1 GENERAL. For service and warranty information on the inverter unit, refer to the manufacturer's instructions, enclosed with this manual. Refer problems not connected to the inverter unit to the General Radio Company Service Department, which will cooperate as much as possible by furnishing information as well as by supplying any replacement parts needed. When writing to our Service Department, please specify the serial and type numbers of the instrument. Also give a complete report of trouble encountered, and steps taken to eliminate the trouble.

Before returning an instrument or part for repair, please write to our Service Department, requesting a Returned Material Tag, which includes shipping instructions. A purchase order covering repair of material returned should also be forwarded to avoid unnecessary delay.

5.2 REPLACEMENT OF VIBRATOR. To replace the vibrator, first remove the instrument from its rack, then remove the cover by releasing the thumbscrews at the rear edges, then remove the left side panel by removing six 3/8-in. and three 1/2-in. Phillips-head screws. Then remove the two screws that attach the end cover of the inverter unit. (Removal of a front-panel snap button provides access to the front screw.) Remove end cover and the old vibrator and plug in the replacement. For data on vibrators, refer to the inverter instructions enclosed. When replacing the inverter cover, make sure that the sponge-rubber pad is on the vibrator side.



* UPPER CONTACTS CONNECTED WHEN FIELD COIL IS ENERGIZED.
SPRING RETURNS TO LOWER CONTACTS WHEN FIELD IS DE-ENERGIZED.

Figure 7. Schematic Diagram, Type 1116-B, Emergency Power Supply.

CONNECTION DATA FOR T2

LINE VOLTAGE	LINE INPUT TAP	ZENER DIODE VOLTAGE (CR-2)	CONTROL CIRCUIT TAP
105-125 VOLTS	1-3	125-126	4
		119-125	3
		114-119	2
210-250 VOLTS	1-6	125-126	4
		119-125	3
		114-119	2

PARTS LIST

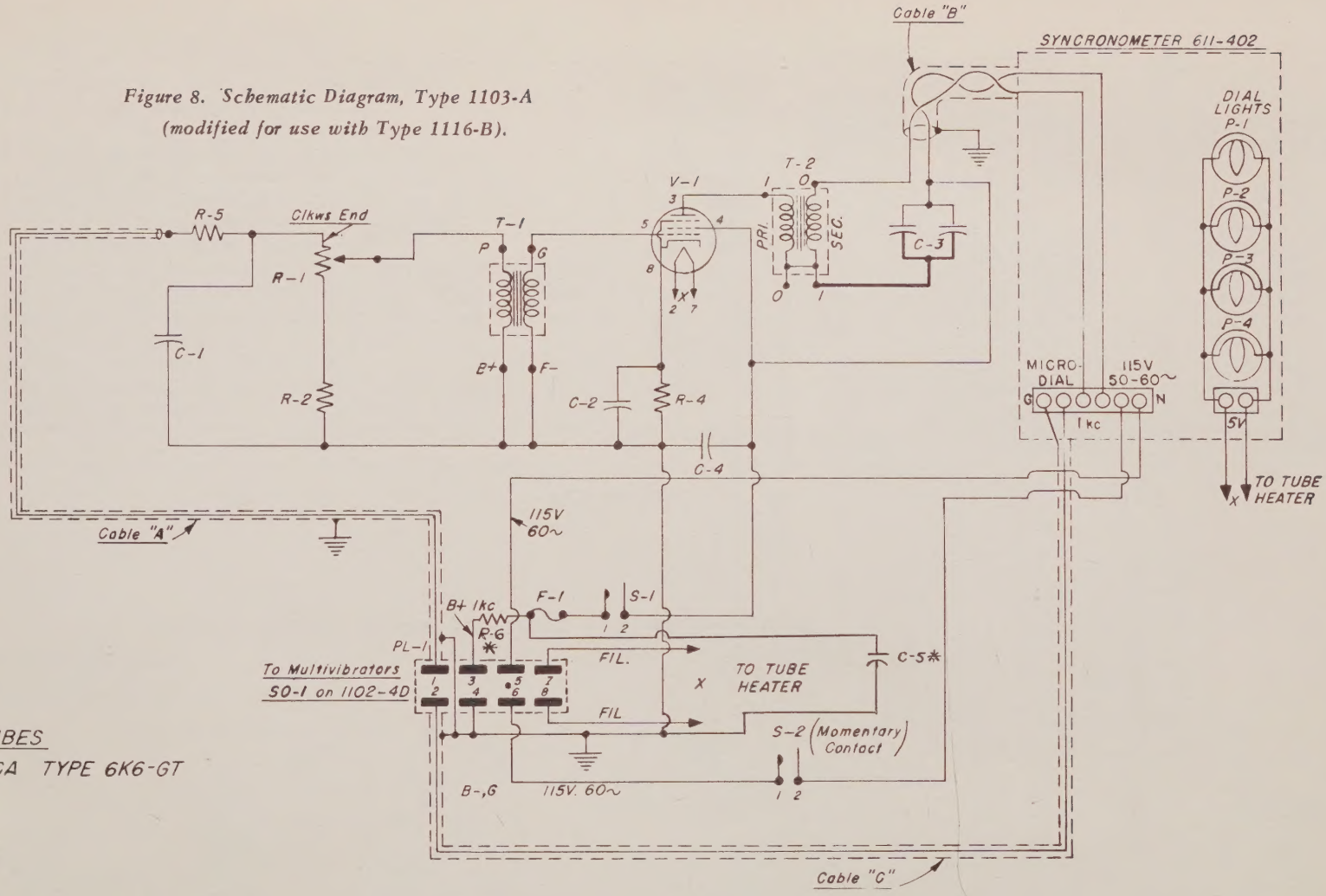
REF NO.	DESCRIPTION	PART NUMBER
R1	RESISTOR, Composition, 100 k ±10% 1/2 w	
R2	POTENTIOMETER, Wire-wound, 250 Ω ±10%	6050-0900
R3	RESISTOR, Power, 100 Ω ±5%	6680-1105
R4	RESISTOR, Composition, 47 k ±10%	6120-3479
C1	CAPACITOR, Oil-impregnated, 0.01 µf ±10% 600 dcwv	4510-4400
C2	CAPACITOR, Oil-impregnated, 0.01 µf ±10% 600 dcwv	4510-4400
C3	CAPACITOR, Electrolytic, 25 µf 200 dcwv (2 sections)	4450-3300
CR1	DIODE, Silicon, Type 1N1695	6081-1002
CR2	DIODE, Silicon, Reference, Type 1N3008B	6083-1023
F1	FUSE, 2 amp Slo-Blo Type 3AG (for 115 v)	5330-2000
F1	FUSE, 1 amp Slo-Blo Type 3AG (for 230 v)	5330-1400
F2	FUSE, 2 amp Slo-Blo Type 3AG (for 115 v)	5330-2000
F2	FUSE, 1 amp Slo-Blo Type 3AG (for 230 v)	5330-1400
F3	FUSE, 0.15 amp Slo-Blo Type 3AG	5330-0500
P1	PILOT LAMP, Neon, 115 v, Type NE-51	8390-0600

REF NO.	DESCRIPTION	PART NUMBER
RE1	RELAY, dpdt, 115 v	0583-0420
RE2	RELAY, dpdt, 115 v	0583-0420
RE3	RELAY, spdt, 12 v	0583-4100
S1	SWITCH, dpst	7910-1700
S2	SWITCH, dpst	7910-1300
S3	SWITCH, dpst	7910-1300
T1	TRANSFORMER	0685-4140
T2	TRANSFORMER	0345-4750

NOTE

When ordering replacement parts, please specify the instrument type number as well as Part Number of the items required.

Figure 8. Schematic Diagram, Type 1103-A (modified for use with Type 1116-B).



TUBES

V-1 = RCA TYPE 6K6-GT

PARTS LIST

C1	CAPACITOR, Mica, 0.05μf ±10%, 600 dcwv	COM-50B	R1	RESISTOR, 50k	301-469	S1	SWITCH, spst toggle	SWT-323
C2	CAPACITOR, Oil-impregnated, 2μf ±10%	COL-6	R2	RESISTOR, Composition, 25 k ±10%, 1 w	REC-30BF	S2	SWITCH, spst push-button	SWP-809
C3	CAPACITOR, Mica, 0.0125μf ±10%, 600 dcwv	COM-50B	R4	RESISTOR, Wire-wound, 1 k ±10%, 1 w	REW-4C	T1	TRANSFORMER	346-H
	CAPACITOR, Mica, 0.0125μf ±10%, 600 dcwv	COM-50B	R5	RESISTOR, Composition, 0.1M ±10%, 1 w	REC-30BF	T2	TRANSFORMER	693-30
C4	CAPACITOR, Oil-impregnated, 5μf	COL-5	*R6	RESISTOR, Wire-wound, 750Ω ±10%, 1 w	REW-4C	V1	TUBE	6K6-GT
*C5A	CAPACITOR, Oil-impregnated, 5μf	COL-9	P1	LAMP, 6.3 v, Mazda Type 44	2LAP-939			
*C5B	CAPACITOR, Oil-impregnated, 5μf	COL-9	P2	LAMP, 6.3 v, Mazda Type 44	2LAP-939			
*C5C	CAPACITOR, Oil-impregnated, 5μf	COL-9	P3	LAMP, 6.3 v, Mazda Type 44	2LAP-939			
F1	FUSE, 0.2 amp Slo-Blo Type 3AG	FUF-2	P4	LAMP, 6.3 v, Mazda Type 44	2LAP-939			

*Parts added for use with Type 1116-B

NOTE: When ordering replacement components, be sure to include complete description as well as Part Number. (Example: R9, 3k ±10%, 1w, REC-20BF.)

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